Space Weather Technical Forecast

Issued on Monday, 19 February 2024 at 01:13 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of isolated M-class flares.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Low solar activity with the peak flare a C5.0 at 18/0405UTC from AR3576 over the southwest limb, and a general decreasing trend in the magnitude and frequency of lower level C-flares. There are currently six sunspot region on the visible disc with the most notable being the large mature unipolar spot AR3590, which has recently rotated onto the northeast disc. There is some notable looping evident in SDO imagery, which suggests that either additional spots or complexity has the potential to become apparent as it moves to a less oblique viewing angle. AR3583 nearing the northwest limb is the next noteworthy region, however any growth of this spot appears to have now stalled, with a potential weakening trend, although this is hard to assess due to the spots location.

No Earth-directed CMEs were observed.

Solar Wind / Geomagnetic Activity: Slow wind conditions were observed at L1 by ACE. Solar winds speeds were at ambient background 300-350 km/s. Density was below average. Interplanetary Magnetic Field (IMF) Bt, was generally weak at 4-8nT. North-south component of the magnetic field, Bz, was predominately negative (southward) with minimum -8nT just after 18/0000 UTC, but became weak thereafter. Brief positive (northward) spells were observed, peaking near 6nT around 18/1030 UTC. Phi was positive (away from the Sun). Geomagnetic activity was initially Unsettled (Kp3) but eased to be Quiet from 18/0300 (Kp0-3).

Energetic Particles / Solar Radiation: GOES18 high energy (greater than 10MeV) proton flux was just above background. Electron flux (greater than 2MeV) has been at background with electron fluence well below the Active (1e8 integrated pfu) threshold. The observed fluence at 19/0000UTC was 9.36e5 pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Low to Moderate activity expected, with a chance of isolated M-class flares, mainly from AR3890 in the northeast. This risk has the potential to increase late in the period with the return of previously active sunspot AR3575 onto the southwest disc, which has likely been the source of a number of far-side eruptions.

Solar Wind / Geomagnetic Activity: Recent CMEs are expected to either miss or only have very minimal impact on Earth, with the most likely for an Earth-directed component being the filament eruption from the north-disc on 16 Feb, passing near Earth day 1-2 (late 19 Feb or early 20 Feb). No other significant solar wind enhancements feature in the period with mainly background winds expected. Geomagnetic activity is expected to be mostly Quiet, but with a chance of becoming Unsettled with Active intervals with any CME arrival day 1-2 (19-20 Feb).

Energetic Particles / Solar Radiation: GOES18 high energy (greater than 10MeV) proton flux will continue to gradually ease to background, but with a slight chance of further enhancement on day 1 or 2 (19-20 Feb) if any significant flares occur from AR3576 just over the limb. High energy electron flux (greater than 2MeV) is expected to remain at background levels. The

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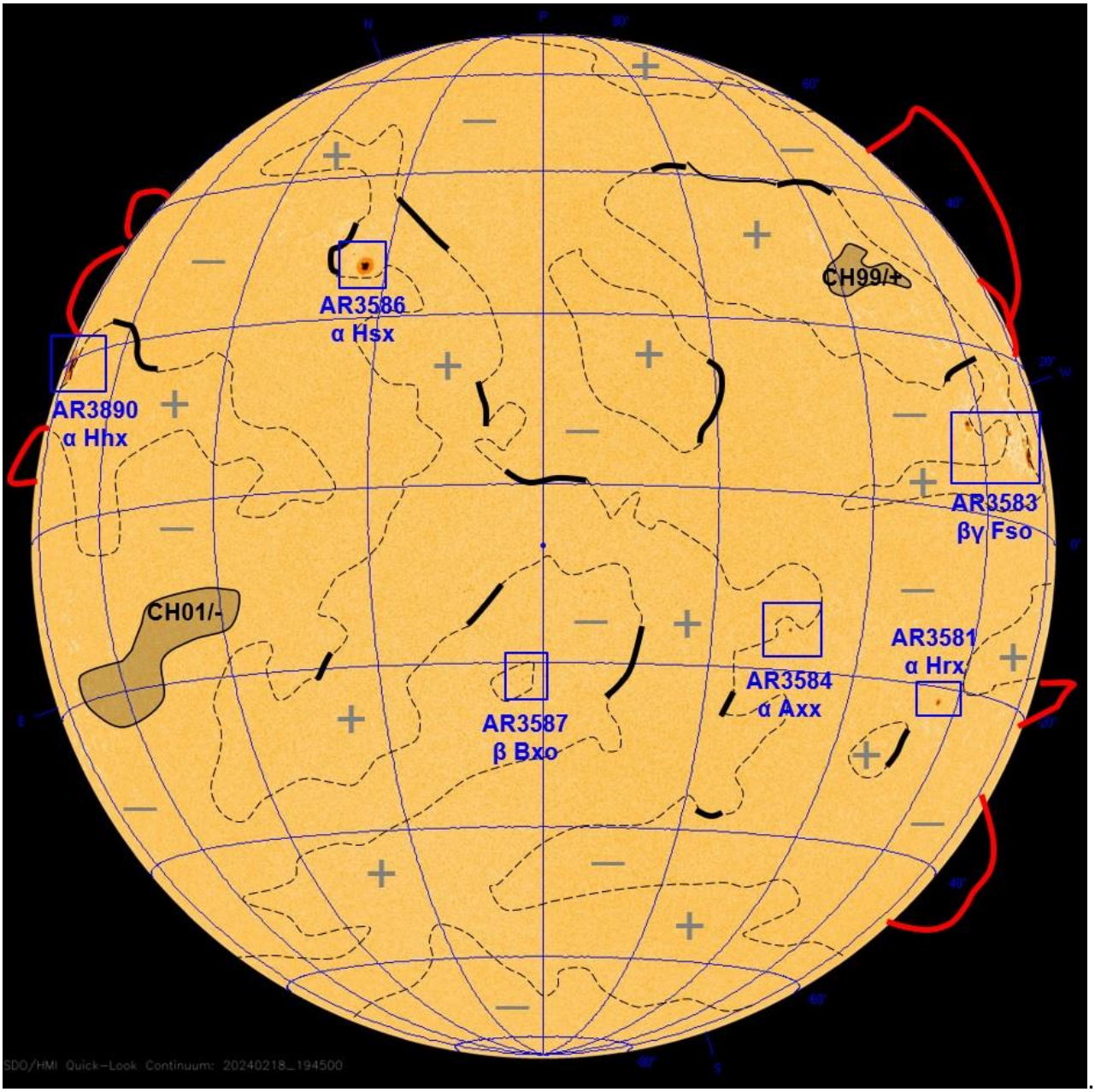
associated 24-hour electron fluence is expected to stay below the Active threshold.

Figure 1. Solar Analysis Valid 18/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

There is one CME that may have an Earth-directed component. This was a result of a filament eruption from the north centre disk on 16 Feb. The majority of the ejecta is expected to travel north above Earth's orbit, but with the potential for some glancing influence either later day 1 (19 Feb) or early day 2 (20 Feb).

Otherwise, current slow wind conditions with background speeds are expected to persist, with the only coronal holes on the Earth facing disc small and too far north to influence solar winds at Earth, or too far east to have any effect through this period.

Geomagnetic activity is expected to be mostly Quiet through this period, perhaps becoming Unsettled with a chance of Active intervals with any CME arrival on days 2-3 (19-20 Feb). There is a very slight chance of G1/Minor Storm intervals.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	5	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
16/0755	Nil	Filament	NW	770 km/s	19/1800 -9/+12 hours	Likely missing, with glancing impact at most. Low confidence.

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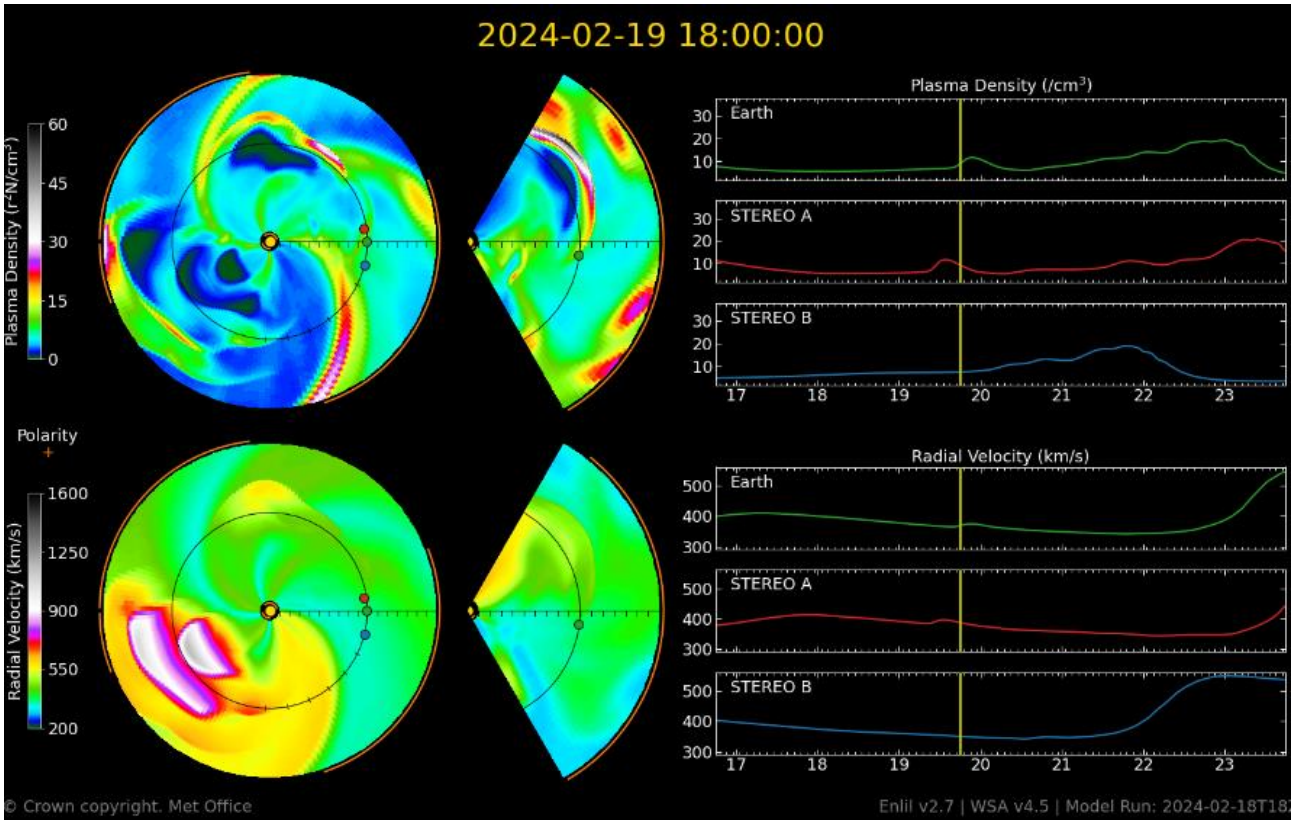
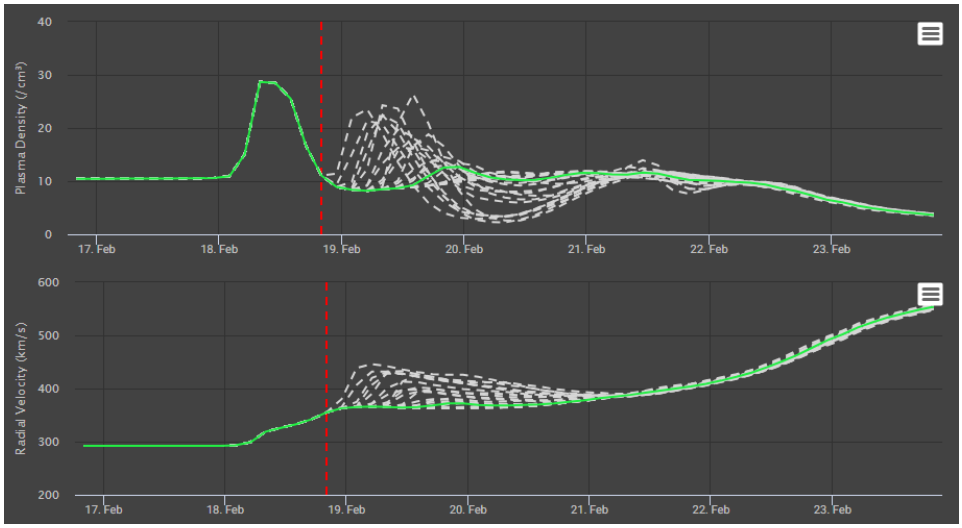
Figure 2: Enlil and ensemble





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Radio Blackouts - X-Ray Flares:

Low solar activity is expected, with a chance of rising to Moderate due to any isolated M-class flares.

The main risk of flaring appears to be from AR3590 near the northeast limb, or any subsequent region that may follow it. While currently appearing to be a large but simple unipolar spot, this region remains bright on various SDO imagery e.g. aia-94 suggesting further complexity is possibly hidden or obscured due to its oblique viewing angle. The only other region of note on the disc is AR3583, which showed some growth on 17 Feb, but has subsequently seen any development stall. This now appears to be weakening, but is also approaching the west limb, so this may be due to the increasing viewing angle.

Later in the period, most likely day 3 or 4 (21-22 Feb), AR3575 is expected to return over the east limb. This was the source of the X3.3 flare on 08 Feb, and has likely been the source of a number of large and southward directed eruptions while this region transited the far-side. However it remains uncertain how much of this spot remains.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	40	40	40	40
Very Active	R3 to R5 X Class	No	5	5	5	5

Figure 3a: GOES-16/18 X-ray flux

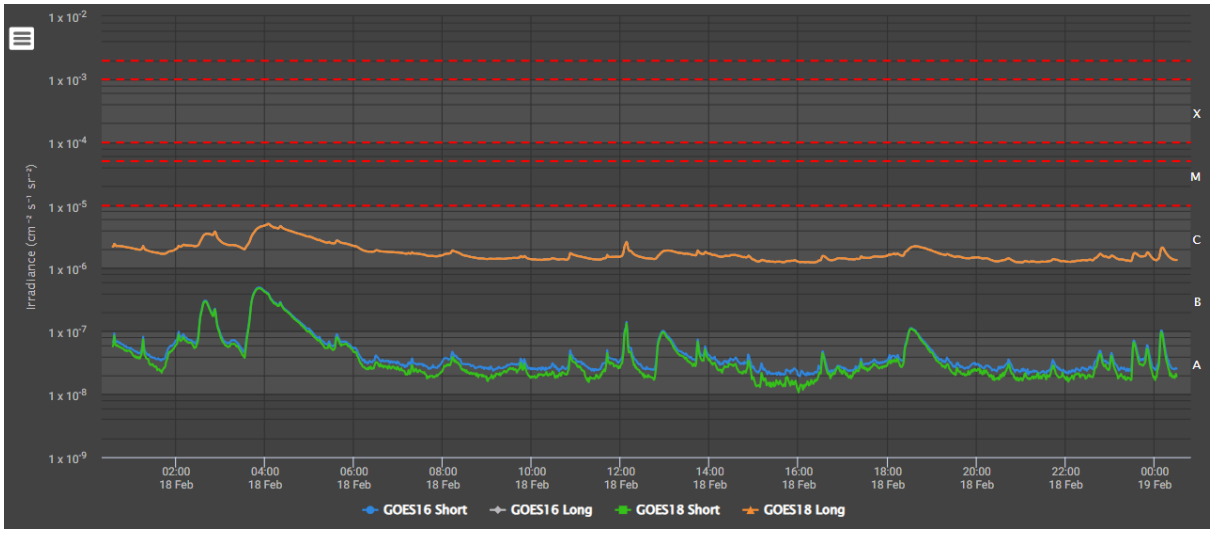

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Figure 3b: SDO aia 94/171/211 and 304 imagery of the looping above AR3576 (top) beyond the SW limb

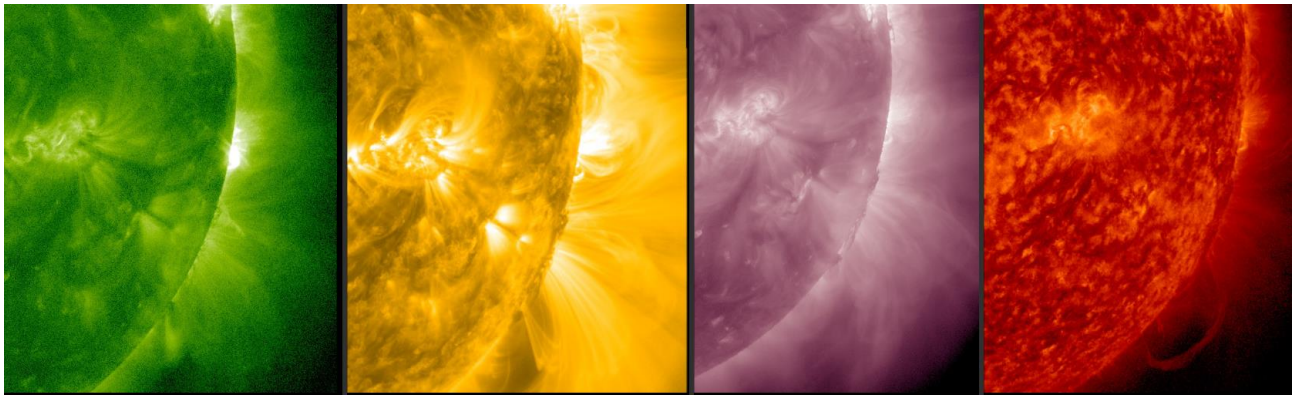


Figure 3c: SDO aia 94/171/211 and Intensitygram imagery of AR3590 on NE limb, with further magnetic looping beyond

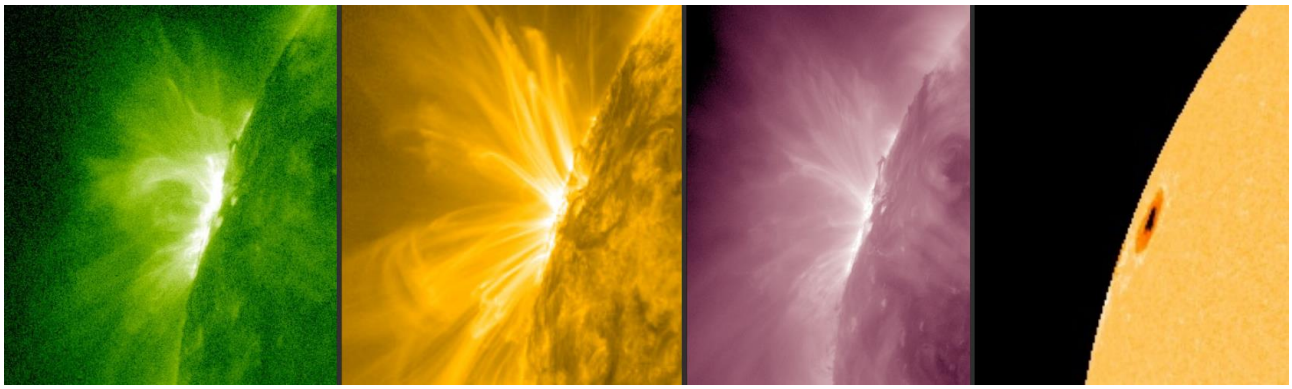
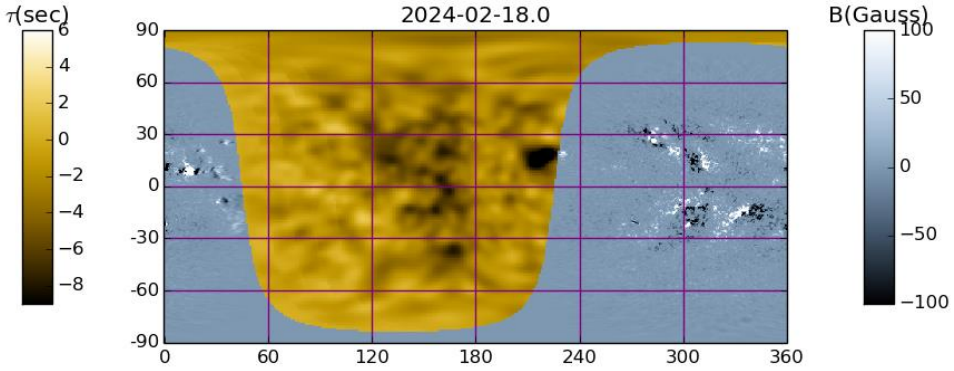


Figure 3d: Far-side helioseismic imagery from jsoc.stanford.edu showing strong returns coming onto NE limb and also a far-south region, likely AR3575.



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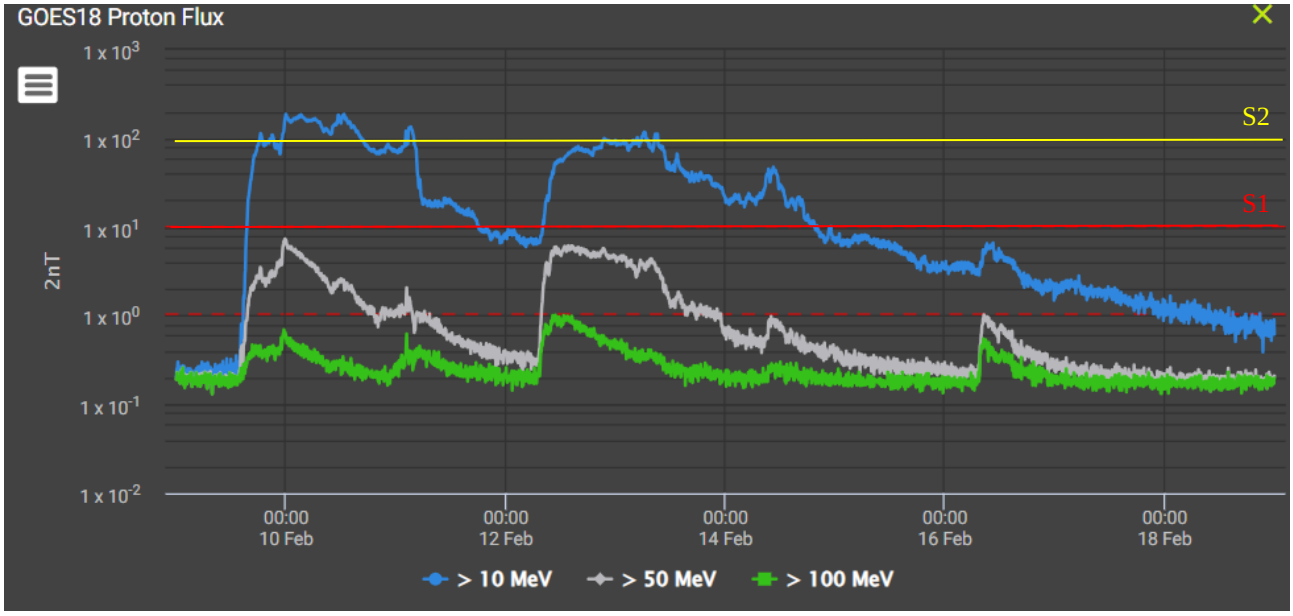
Solar Radiation Storms - (High Energy Protons):

GOES 18 high energy (greater than 10MeV) protons have settled close to background levels in the past 24 hours. AR3576 will continue to give a decreasing risk for further proton enhancements as it moves across the far-side. The current regions on the Earth-facing disc have a lower chance of notable flares, and are currently considered unlikely sources of further solar storms.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	1	1
Very Active	**≥ S3 ***	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

Figure 4: GOES-18 >10 MeV >50MeV and >100 MeV flux since 09 Feb



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High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2MeV) at GOES16 is expected to remain at background levels. There are no significant coronal hole fast wind enhancements expected, and any potential CME glancing blow on day 3 most likely to be weak. These are not expected to drive a significant increase in electron flux.

24-hour fluence values are expected to continue well below the Active (1e8 integrated pfu) threshold, as suggested by REFM which is considered to be providing good guidance.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	1	1
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

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